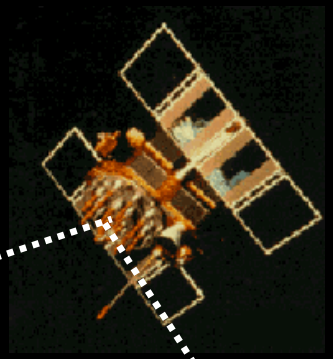
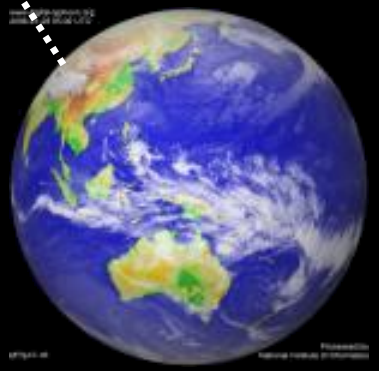
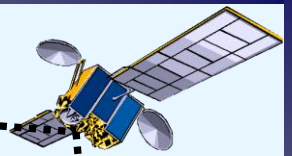


Global Positioning System (G.P.S.)





Glossary

GPS – Global Positioning System

GIS – Geographic Information System

GNSS – Global Navigation Satellite System

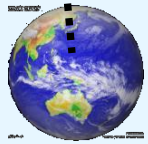
RTK – Real-Time Kinematic

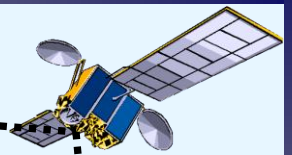
Other GPS Systems

Glonass – Russian satellite system

Galileo – European satellite system

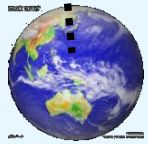
Compass – Chinese satellite system

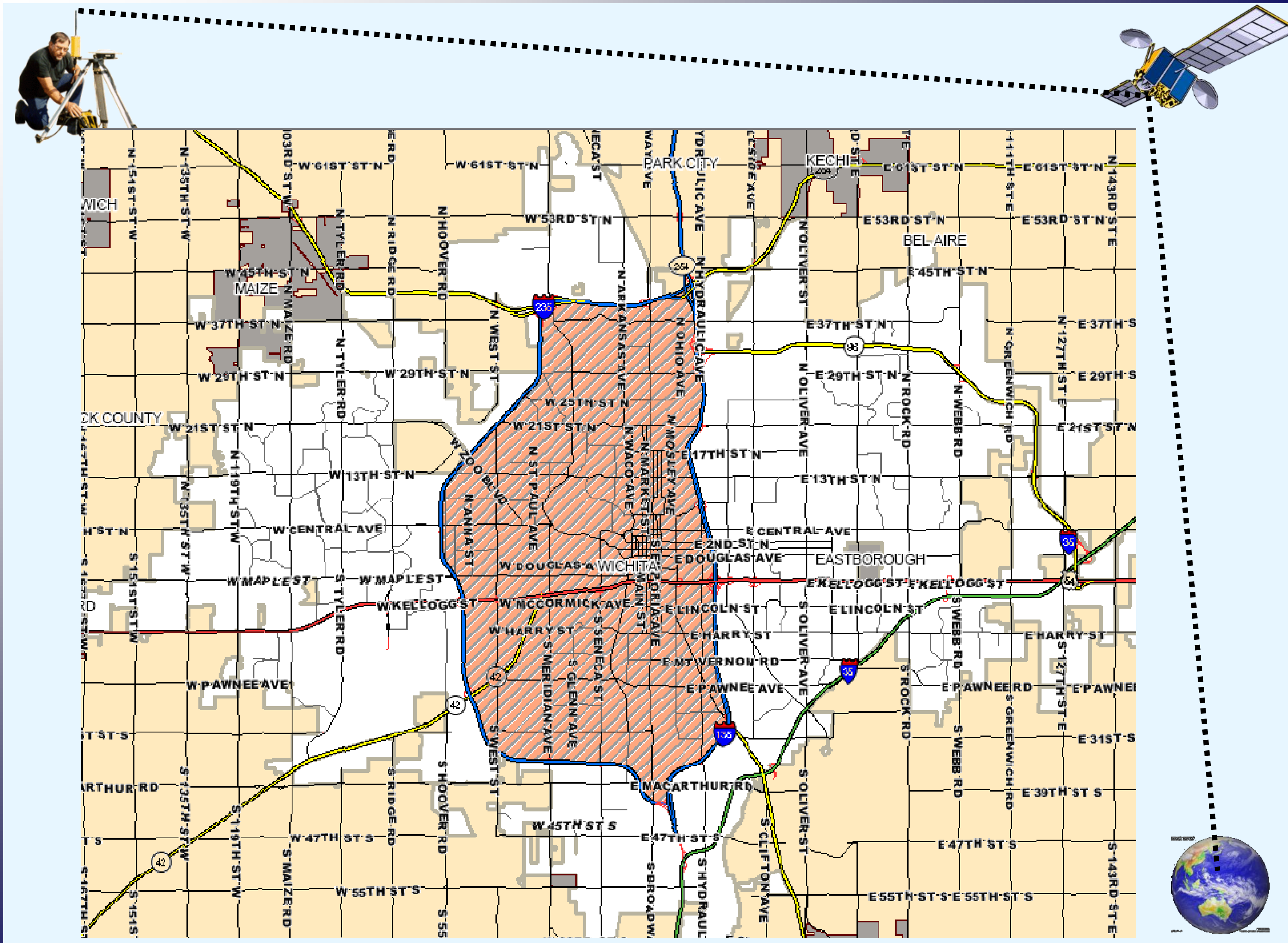




Background

- 2004: Storm Water Utility re-organized
- 2005: Determined the need for a detailed drainage inventory
- 2006: Council approved $1,000,000 to begin digital inventory of the Storm Water system and structures





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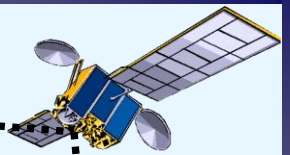

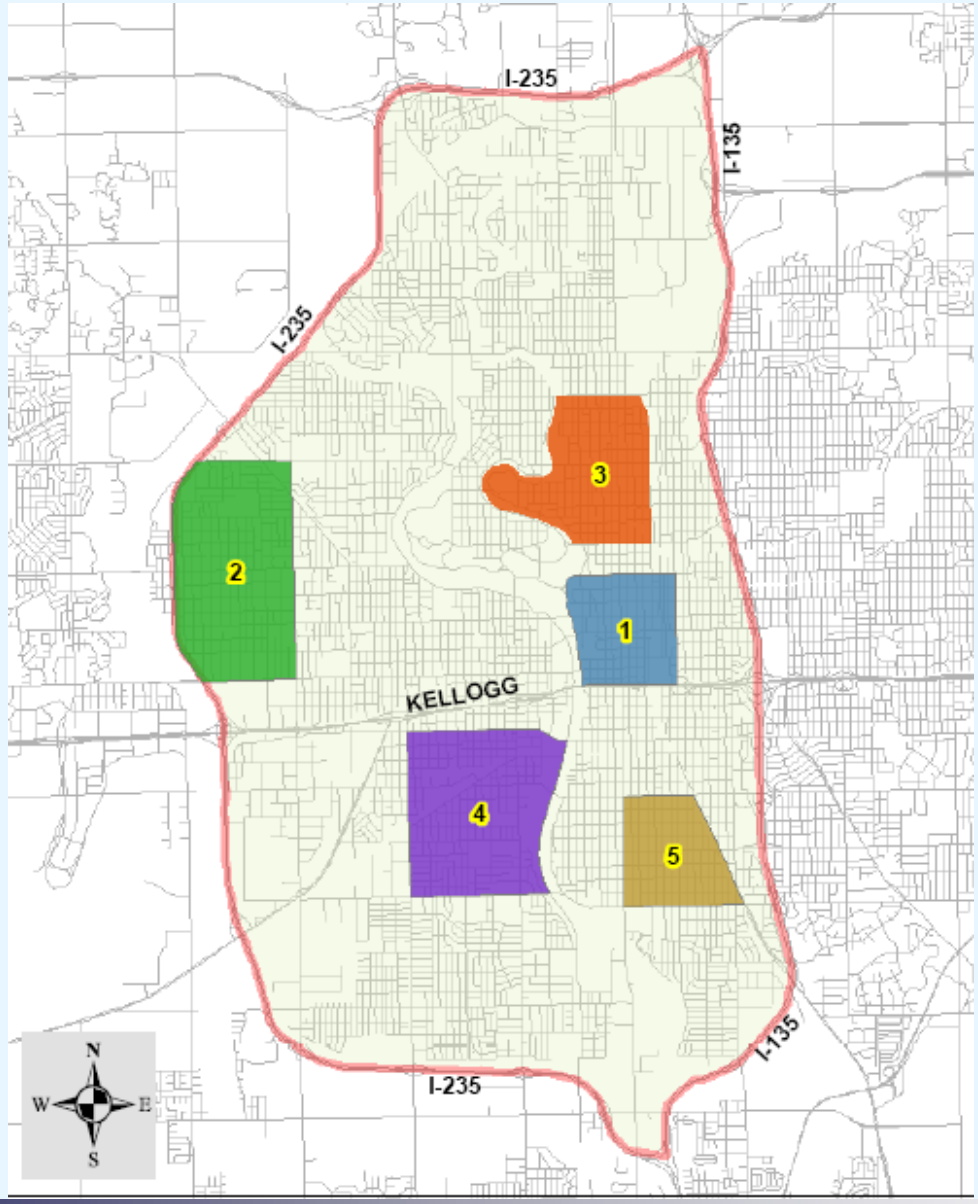
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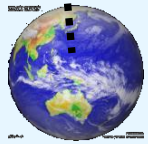
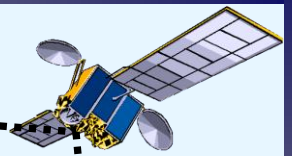
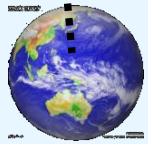
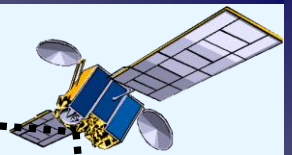




Staff's Challenge

- How to accomplish this in the most economical and efficient manner possible?
- Answer: Use of G.P.S.
  - Questions remained:
    - How Accurate?
    - How Expensive?





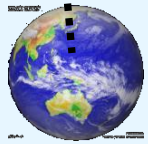
Challenges (cont.)

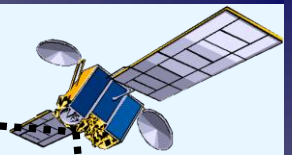
- We knew there were several recent developments occurring in G.P.S. technology.
- If we hired a consultant to inventory – they would need a ‘rover’ and ‘base station’.

Answer

Why not install our own base stations.

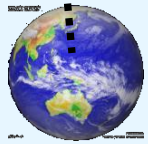
CO-OP with COUNTY & WESTAR

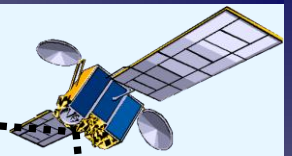




History of G.P.S.

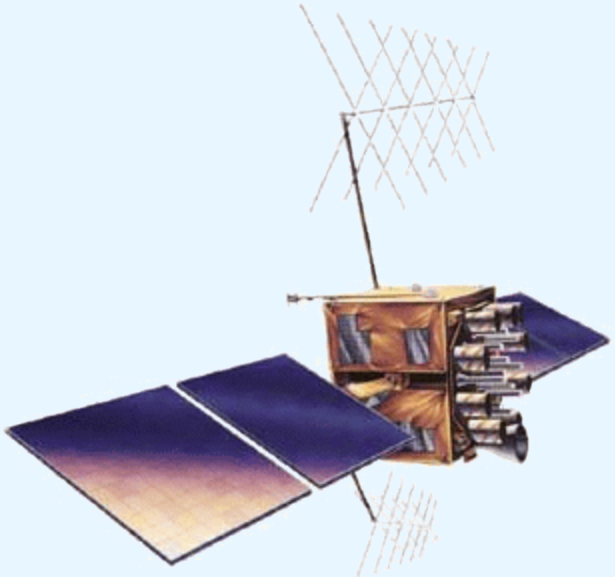
- 1978 – 1st GPS satellites launched
- 1983 – “FREE TO THE WORLD”
- March 1994 – 24th satellite launched
- May 2000 – Discontinue degradation of code
- February 2007 – Accuracy to within 1 cm.

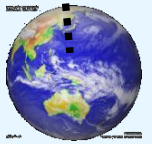




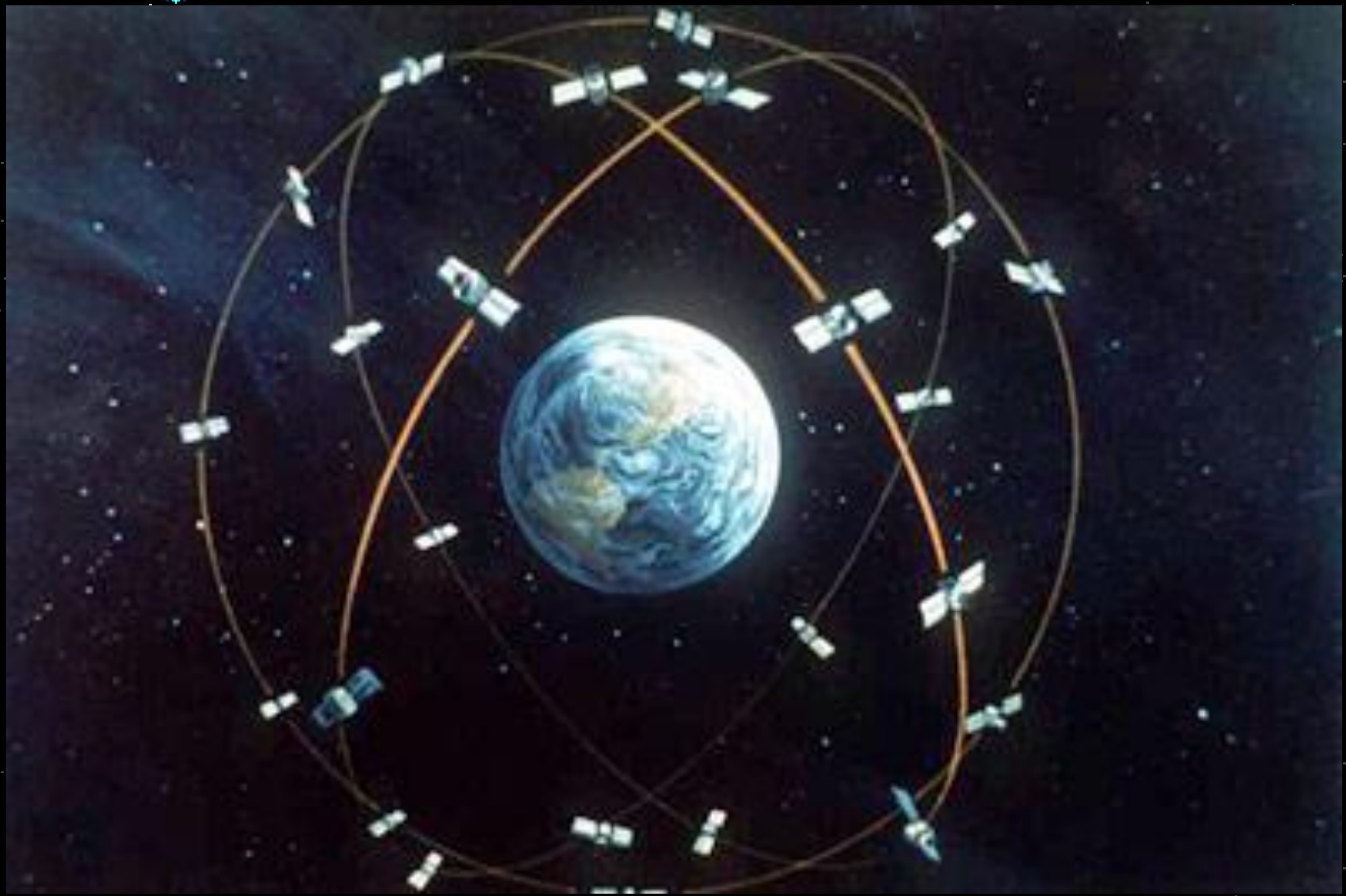
How GPS Works

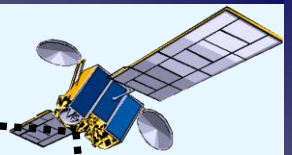
- Constellation of 31 Earth-orbiting satellites (Maximum number that can be operational)





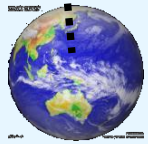
March 15, 2008

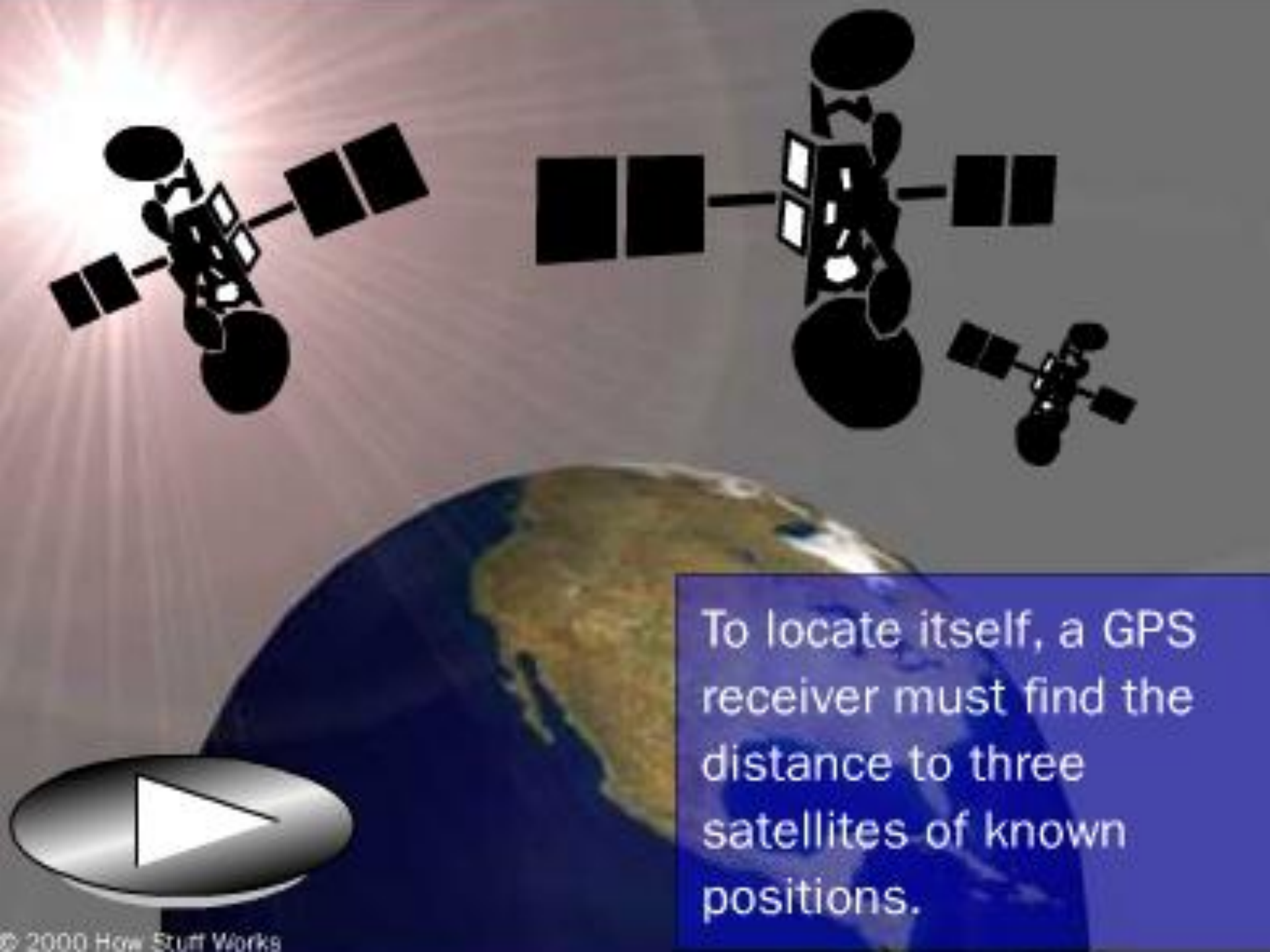


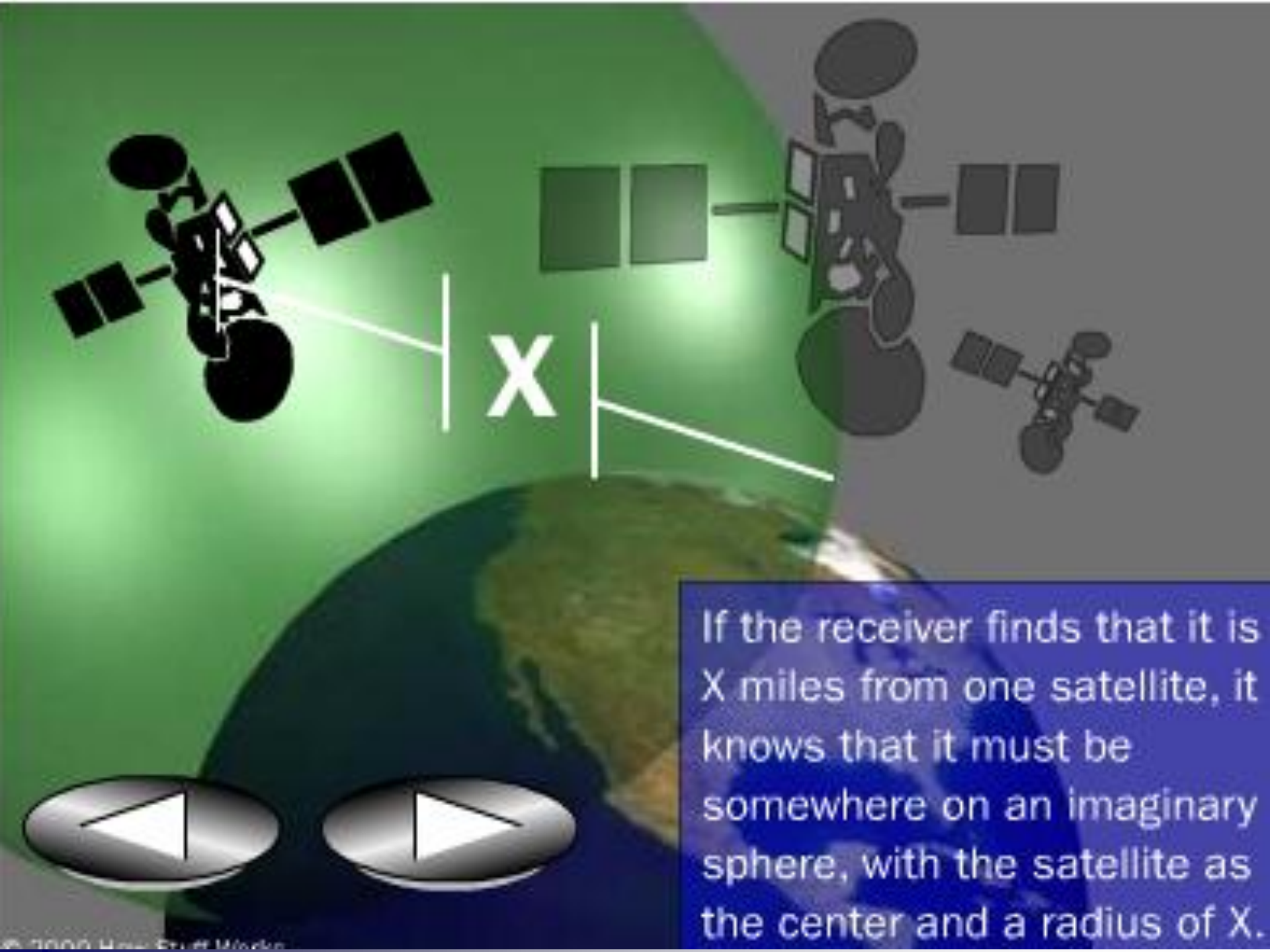


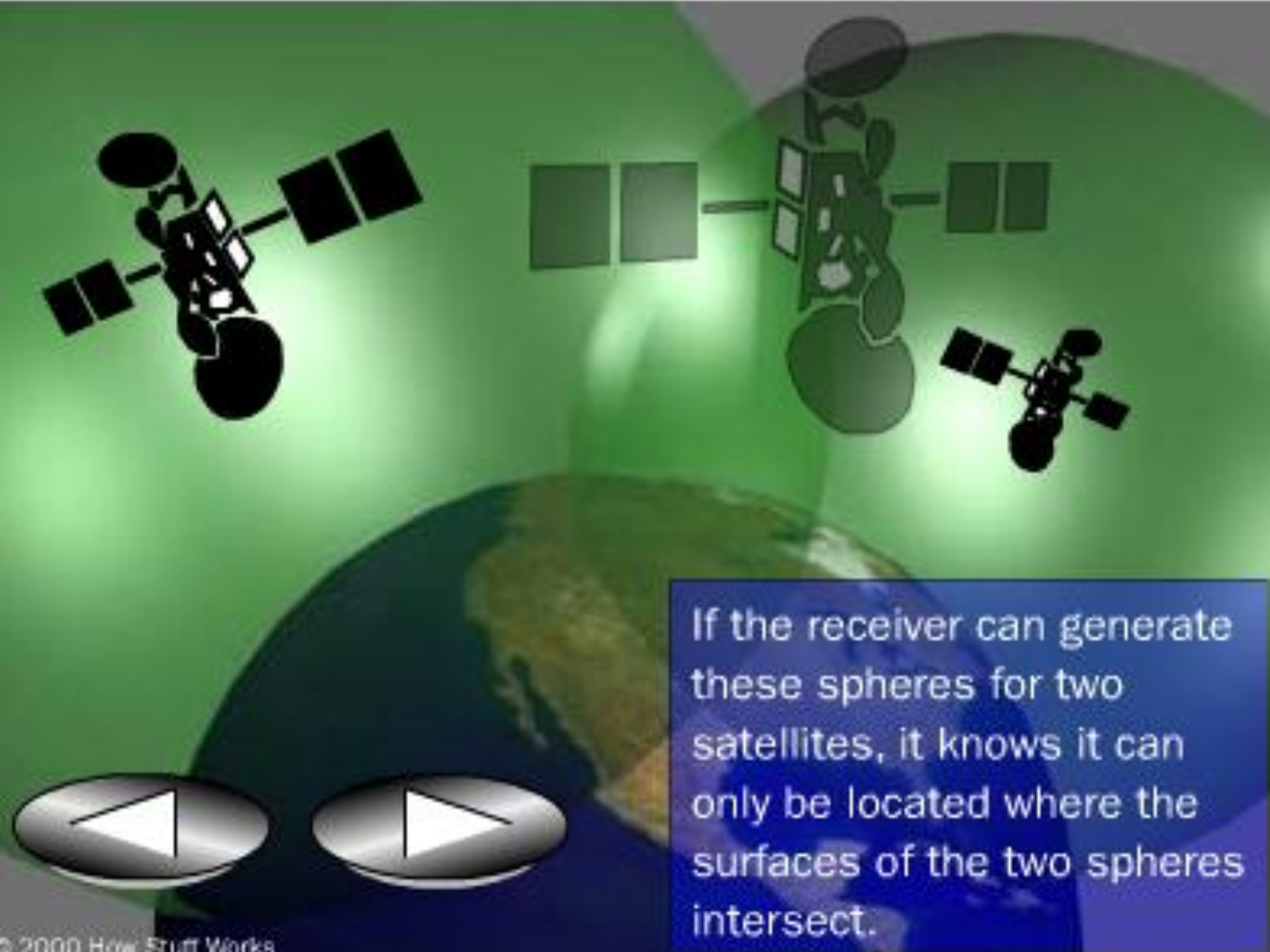
How GPS Works

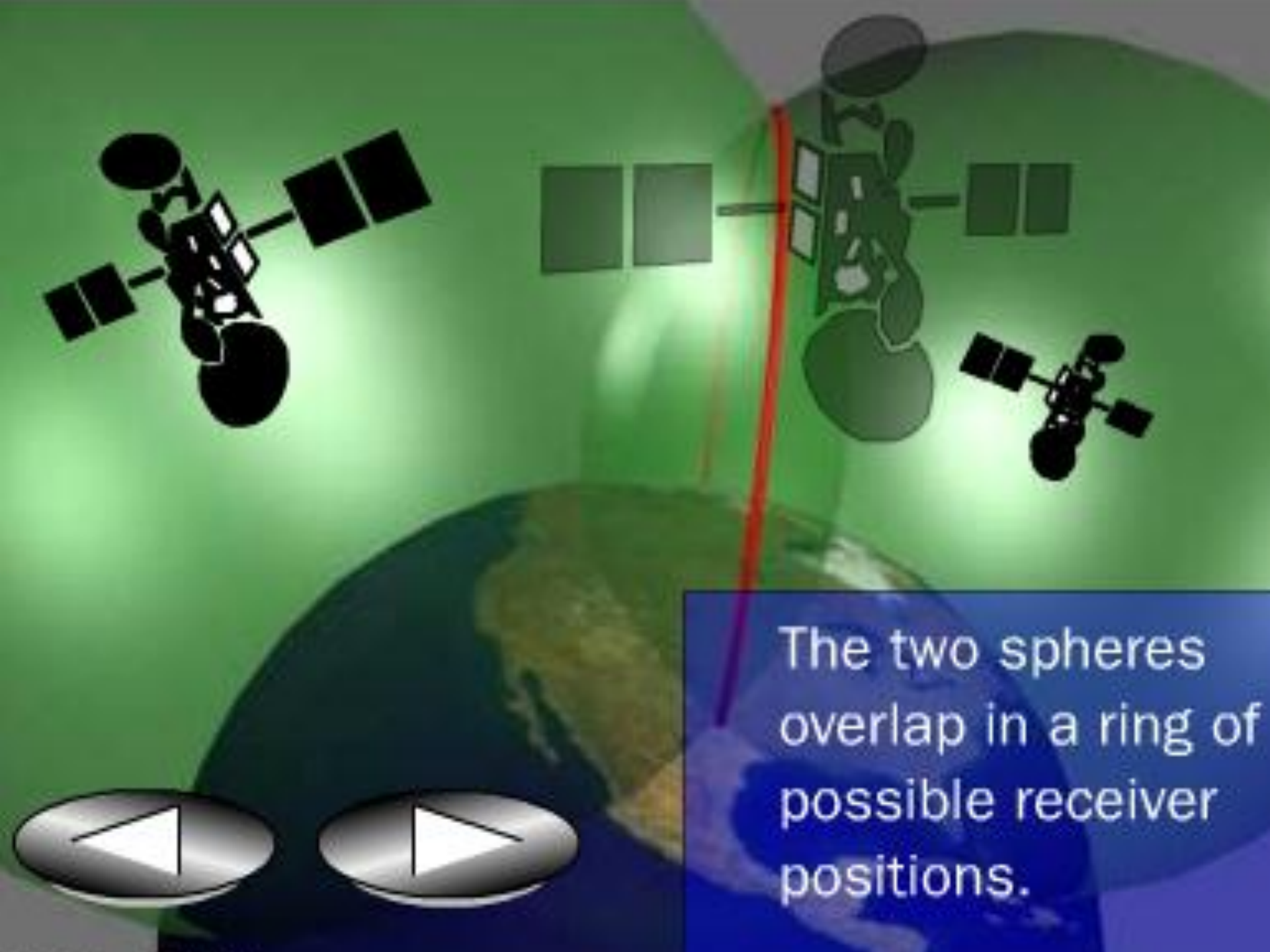
- Satellites circling the globe make two complete rotations a day.
- Orbits are arranged so that at any given time anywhere on Earth there are at least 4 satellites “visible” in the sky
- GPS receivers locate four or more of these satellites, determine the distance to each, and use this information to deduce its own location.
- This operation is based on a simple mathematical principle called ‘trilateration’.

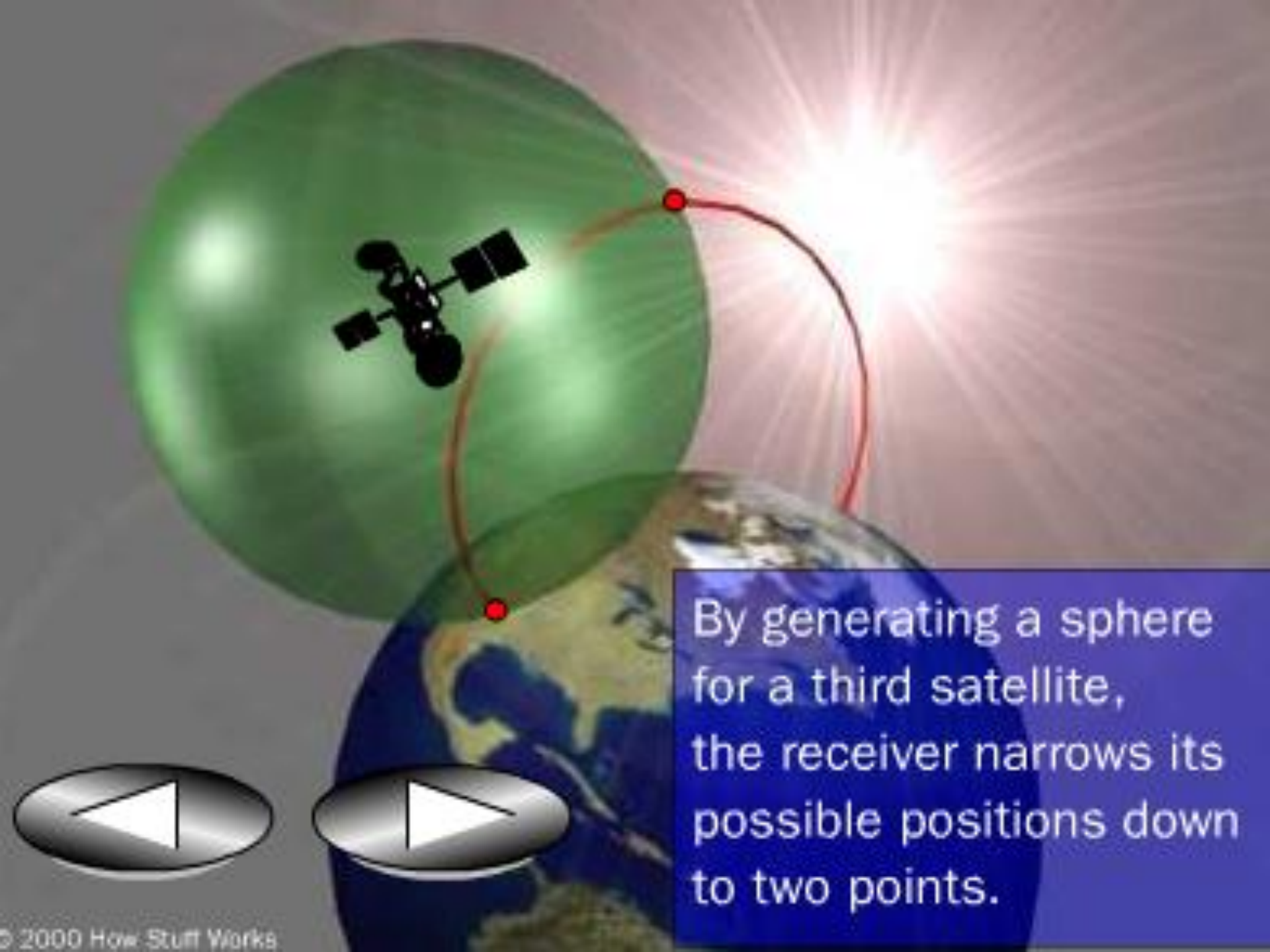




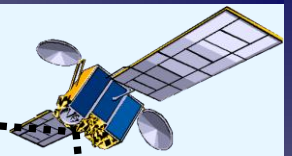

X
If the receiver finds that it is X miles from one satellite, it knows that it must be somewhere on an imaginary sphere, with the satellite as the center and a radius of X.




The two spheres overlap in a ring of possible receiver positions.

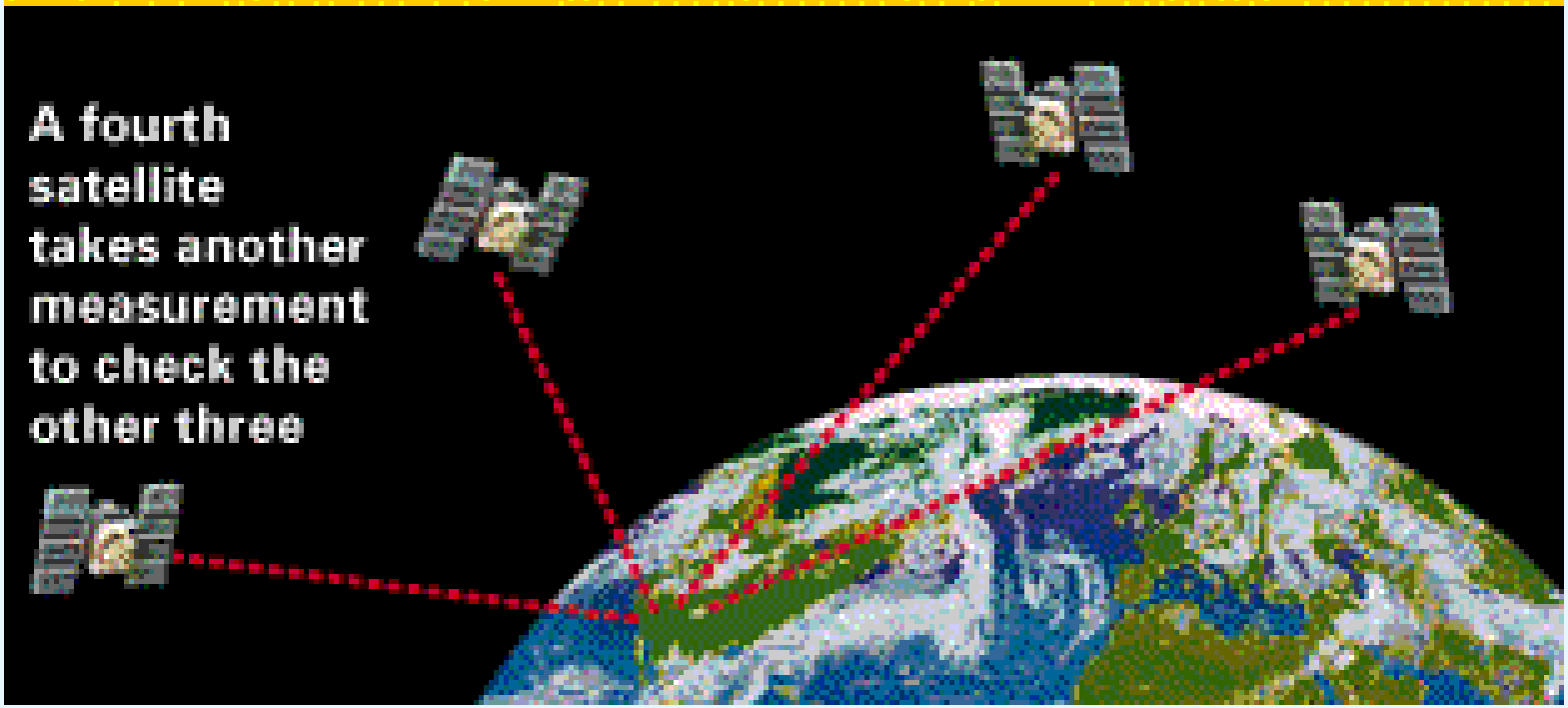

By generating a sphere for a third satellite, the receiver narrows its possible positions down to two points.
© 2000 How Stuff Works

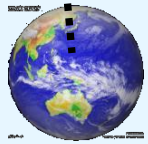

The receiver dismisses the point located in space, leaving only one possible position.
© 2000 How Stuff Works

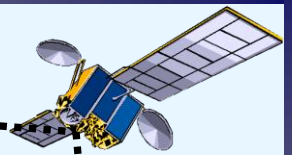


A fourth satellite makes timing perfect

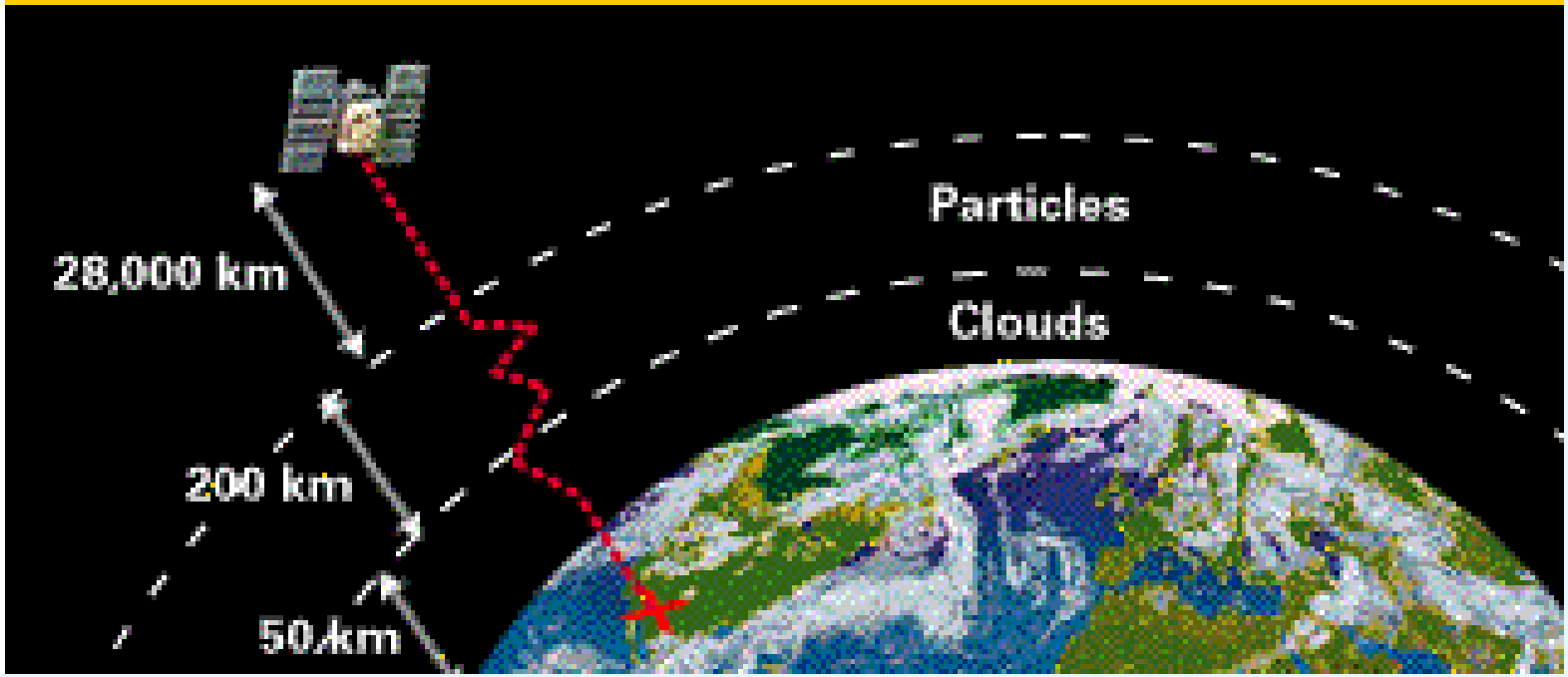
A fourth satellite takes another measurement to check the other three

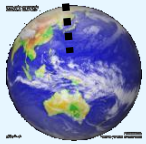




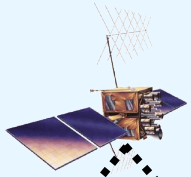


In review: Error correction





Real – Time Kinematic

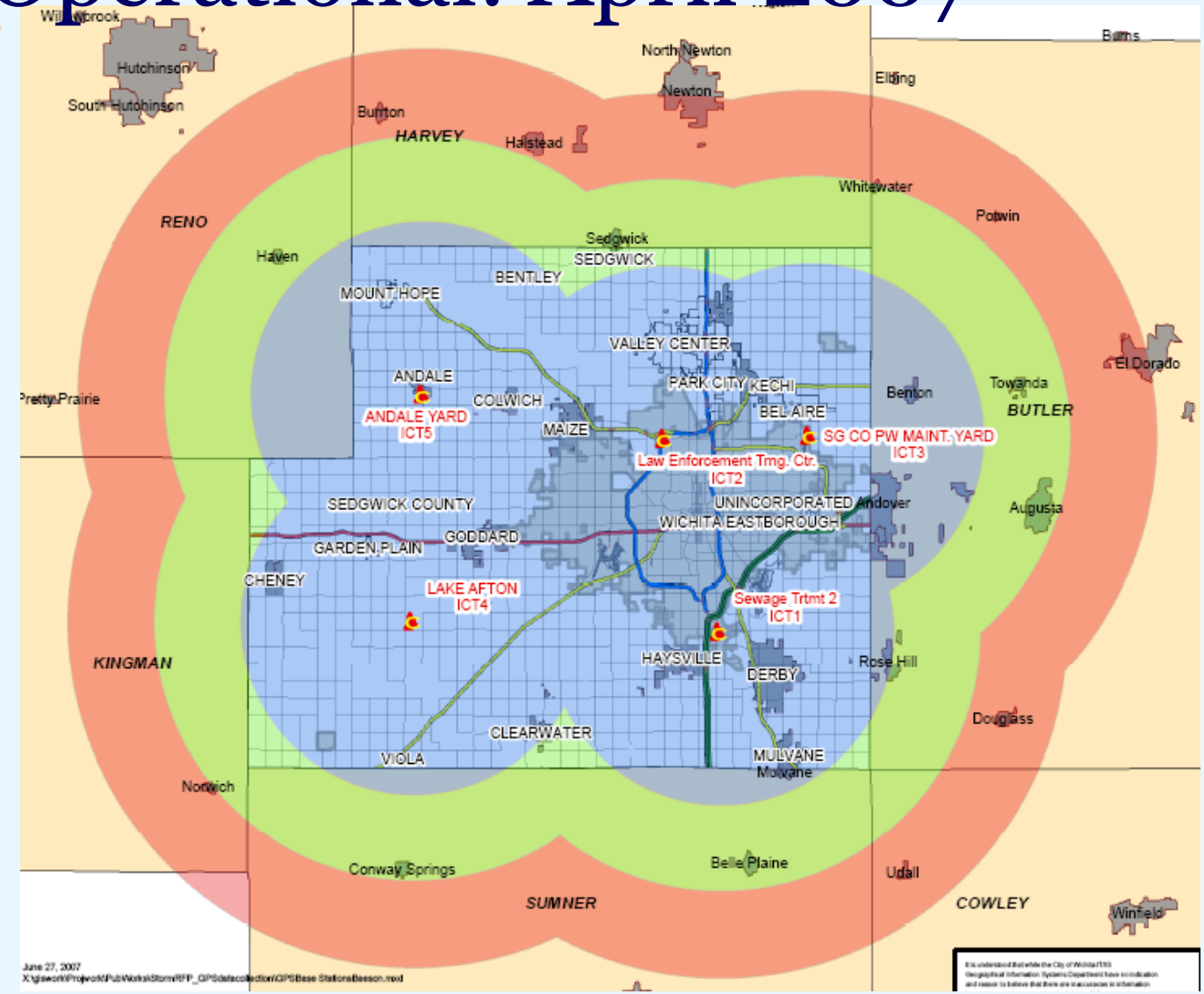


Satellite

Base
Referencing
Station

Rover

Operational: April 2007

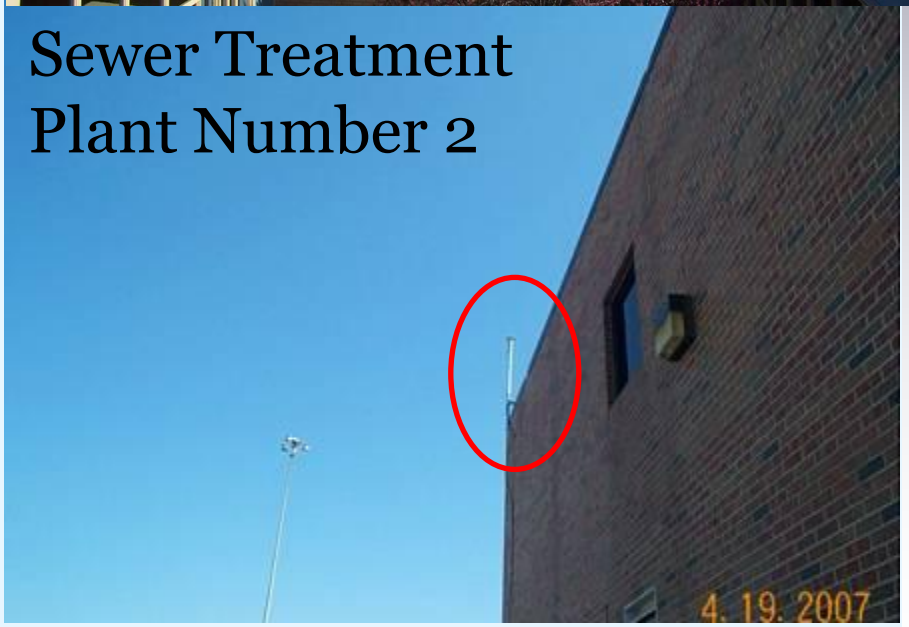


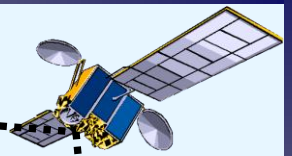
Lake Afton

Police Training Center

Base Referencing Station

Sewer Treatment Plant Number 2



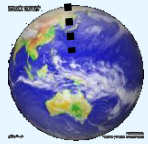


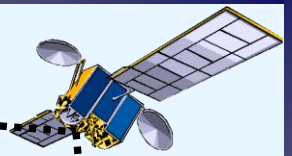
Costs

2 base stations:	<$40,000
Spider Network:	<$50,000
Total Setup:	<$100,000

Savings

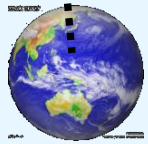
- Lower fees for Storm Water Inventory
- Lower fees for levee certification
- Lower fees for digital topography

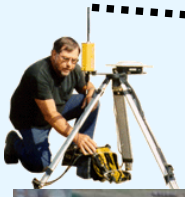




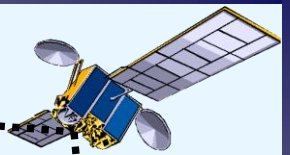
G.P.S. Surveying

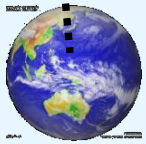
- Construction Section
  - Horizontal and vertical control of close to 300 projects annually
  - Projects have a total value of over $70,000,000
  - Projects have become more complex
- Mass grading projects are now a standard part of subdivisions
- City survey crews still stake streets, sewers, waterlines and bridges



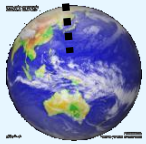


Krug North

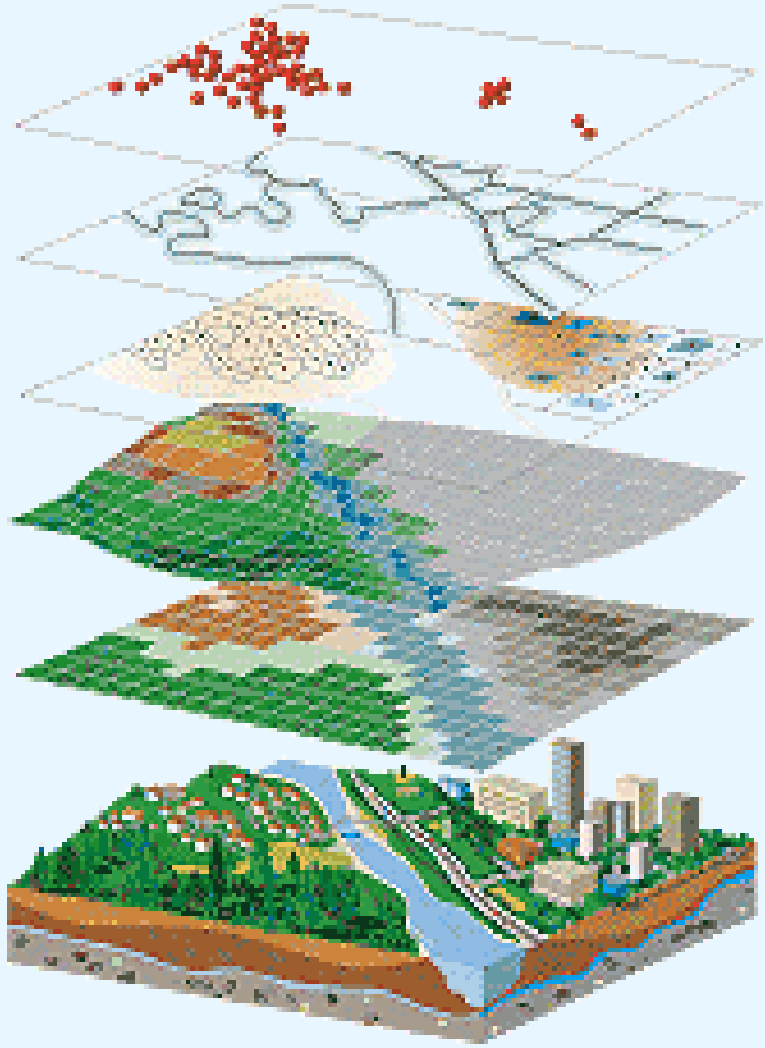


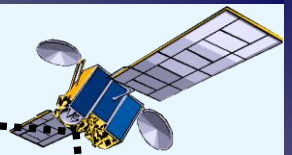


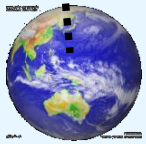
Krug North

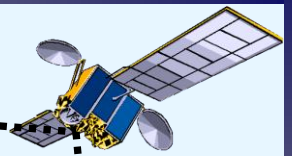


Comparison Current/Future









USER FEES/ MAINTENANCE FEES